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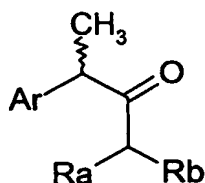
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(54) Title: **CHIRAL ARYLKETONES IN THE TREATMENT OF NEUTROPHIL-DEPENDENT INFLAMMATORY DISEASES**



(I)

(57) Abstract: ABSTRACT The compounds of formula (I): where Ar is an aromatic ring and Ra, Rb, are as defined in the description, are useful in therapy as drugs for the treatment of diseases mediated by infiltrations of neutrophils induced by IL-8, such as psoriasis, rheumatoid arthritis, ulcerative colitis and for the treatment of damages caused by ischemia and reperfusion.

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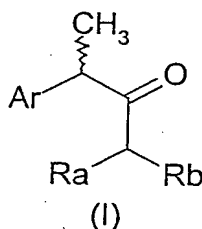
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"CHIRAL ARYLKETONES IN THE TREATMENT OF NEUTROPHIL-DEPENDENT INFLAMMATORY DISEASES" **JC20 Rec'd PCT/PTO 08 JUN 2005**

The present invention relates to chiral arylketones, a process for their preparation, and pharmaceutical compositions containing them, which are useful in the prevention and treatment of tissue damage due to the exacerbated recruitment of polymorphonucleate neutrophils in the inflammatory sites.

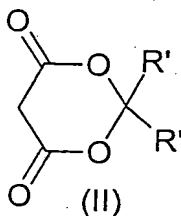
More specifically, the present invention relates to chiral arylketones of general formula I:



wherein:

10 Ar is an aryl group;

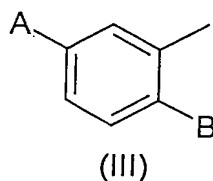
Ra and Rb are independently chosen in the group of hydrogen, linear or branched C₁-C₆ alkyl, phenyl, α-or β-naphthyl, 2, 3, 4-pyridyl, C₁-C₄-alkylphenyl, C₁-C₄-alkyl(α-or β-naphthyl), C₁-C₄-alkyl(2, 3, 4-pyridyl), cyano (-CN), carboxamide, carboxyl or carboxyesters of formula CO₂R" wherein R" is the residue of a linear or branched C₁-C₆ aliphatic alcohol, a phosphonate PO(OR")₂ wherein R" is as defined above, a group of
 15 formula di-X-(CH₂)_n-Z, wherein X is a CO, SO, SO₂ group; Z is H, *tert*-butyl, isopropyl, CO₂R", CN, phenyl, α-or β-naphthyl, 2, 3, 4-pyridyl, C₃-C₆ cycloalkyl, NH-BOC, NH₂; n is zero or an integer from 1 to 3; or Ra and Rb, with the carbon atom to which they are bound, form a cyclic residue 4, 6-dioxo-1, 3-dioxanyl-2, 2-disubstituted of formula II:



wherein R' is methyl or ethyl, or the two groups R' form a cyclohexane or cyclopentane ring.

By aryl group is meant preferably phenyl, optionally substituted by one to three substituents, which are the same or different from one another, selected from atoms of halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, hydroxy, C₁-C₄-acyloxy, phenoxy, cyano, nitro, amino, C₁-C₄-acylamino, halogen-C₁-C₃-alkyl, halogen C₁-C₃-alkoxy, benzoyl, or the aryl portion of known anti-inflammatory 2-aryl-propionic acids, such as ibuprofen, ketoprofen, naproxen, surprofen, carprofen, piroprofen, and fenoprofen.

Preferred residues of 2-aryl-propionic acid are: 4-iso-butyl-phenyl, 3-benzoylphenyl, 5-benzoyl-2-acetoxy-phenyl, 3-phenoxy-phenyl, 5-benzoyl-2-thiophenyl, 4-thienoyl-phenyl, 1-oxo-2-isoindoliny-phenyl, 3-chloro-4-(2, 5-dihydro-1 H-pyrrol-1-yl)phenyl, 6-methoxy-β-naphthyl, 1-hydroxy-phenyl-1-methyl, or a residue of formula III:



wherein A is benzyl, phenoxy, benzoyl, benzoyloxime, 1-hydroxy-phenyl-1-methyl, B is hydroxy, C₁-C₄-acyloxy, or a group of formula -O-C(=S)-N(CH₃)₂; -S-C(=O)-N(CH₃)₂. R is preferably an aryl residue of a known anti-inflammatory 2-aryl-propionic acid, as defined above; more preferably, R represents: 4-(2-methyl-propyl)-phenyl, 3-phenoxy-phenyl, 3-benzoylphenyl, 2-[4-(1-oxo-2-isoindoliny)phenyl], 5-benzoyl-thien-2-yl, 4-thienoyl-phenyl.

Preferred linear or branched C₁-C₆ alkyl and of a residue of C₁-C₆ aliphatic alcohol are methyl and ethyl; C₁-C₄ alkyl is preferably isobutyl; C₁-C₄-acyloxy is preferably acetyloxy.

Particularly preferred compounds of formula I of the invention are those compounds wherein the steric configuration of the carbon atom to which the residue R is bound corresponds to the configuration (R).

The following compounds:

(R, S) (±)-2-butanone, 3-[4-(2-methylpropyl)phenyl] (CAS n°-64758-90-3);

(R, S) (±)-2-butanone, 3-(3-phenoxyphenyl) (CAS n° 108671-27-8);

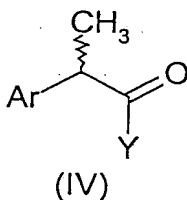
(R, S) (±)-2-butanone, 3-(3-benzoylphenyl) (CAS n° 79868-87-4);

ethyl (R, S) (±)-4-(3-benzoyl-phenyl)-3-oxo-pentanoate (CAS n° 145927-45-3);

(R, S) (\pm)-1, 3-dioxan-4, 6-dione-, 5-[2-(3-benzoylphenyl-1-oxopropyl)]-2, 2-dimethyl (CAS n° 154 023-15-1);

are known as racemic intermediates for the preparation of 2-arylpropionic acids [JP 03024023 (02.01.1991); JP 52108949 (09.12.1991); JP 52083426 (07.1.1977); JP 56097249 (08.05.1981); Tetr. Lett. 27. 4175, 1986] and of thiazoles [EP 511021; (28.10.1992); JP 0528902 (11.02.1993)].

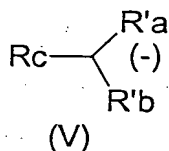
The compounds of formula (I) are obtained by reacting an activated 2-arylpropionic acid of formula IV:



wherein

Ar is as above defined aryl and Y is a residue activating the carbonyl, preferably a halogen, such as chlorine, 1-imidazolyl, pivaloyl, C₁-C₃-alkoxycarbonyl, succinyloxy, benzo-triazol-1-yloxy

with a carbanion of formula V:

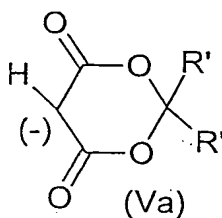


wherein:

when R'a is the residue of a complex between a carboxyl and magnesium ethoxide, R'b is CO₂R'', CONH₂, CN, PO(OR'')₂ or -X-(CH₂)_n-Z', where X is as defined previously;

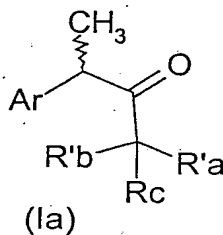
Rc is H or -(CH₂)_n-Z', where Z' is H, *tert*-butyl, isopropyl, CO₂R'', CN, phenyl, α - or β -naphthyl, 2, 3, 4-pyridyl, C₃-C₆ cycloalkyl, NH-BOC;

when R'a is hydrogen and Rc is hydrogen or a -(CH₂)_n-Z' radical, as defined above, R'b is phosphonate PO(OR'')₂, CO₂R'', or R'a and R'b with the carbon atom to which they are bound, form the carbanion at the carbon atom C₅ of a radical 2, 4-dioxo-1, 3-dioxanyl of formula Va:



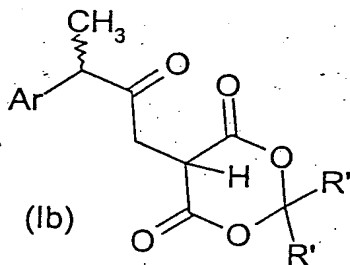
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wherein R' has the meanings indicated above, to yield a compound of formula (Ia):

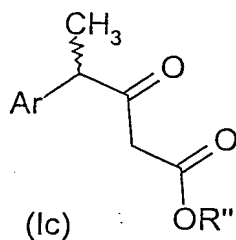


wherein R'a, R'b and R'c have the meanings described above, provided that R'c is hydrogen

10 when R'a and R'b with the carbon atom to which they are bound form 4, 6-dioxo-1, 3-dioxanyl of formula (II), also known as Meldrum adduct of formula Ib:

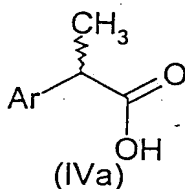


wherein Ar and R' have the meanings described above. If so desired, the Meldrum adducts
 15 are converted by boiling in a linear or branched C₁-C₆ alcohol into the corresponding β-ketoester of formula Ic:



A β -ketoester of formula Ia and Ic may optionally be dealkoxydecarboxylated to the corresponding arylketone of formula I by simply heating in an aprotic solvent (preferably dimethylsulfoxide) in the presence of small amounts of water and, optionally, of small amounts of electrolytes, such as NaCl, NaCN, LiCl, LiI (according to J.P. Krapcho, Synthesis 805 and 893, 1982, and references cited herein). Likewise, using well known methods, a compound of formula Ia can be converted into another compound of formula I by removal of any protective groups that may be present, or by saponification of carboxyl groups, or by conversion of nitriles into carboxyamides.

The compounds of formula IV are obtained in a conventional way, conserving their enantiomeric integrity, starting from the individual enantiomers of the 2-aryl-propionic acids of formula IVa:



which are known compounds and can be obtained from the individual racemates using known methods of optical resolution.

The preparation of the carbanions of formula V consists in a process of C-acylation in virtually neutral conditions, fully described in the literature (see, for example, D. W. Brooks *et al.*, Angew. Chem. Int. Ed. Engl., 18, 72, 1979), as well as monoesters of malonic acids and of monosubstituted malonic acids, also on sulfinylacetic acids, sulfonylacetic acids and phosphonoacetic acids. All these acids are known in the literature or can be prepared using known methods, such as monosaponification of diesters of

malonic acids and their monosubstituted analogues or saponification of phosphonoacetic acids and 2-substituted analogues; sulfinylacetic and sulfonylacetic acids may be obtained by oxidation of ethers of thioglycolic acid. Alternatively, it is possible to use lithium enolates of formula V, obtained by reaction of lithium alkyls with known alkyl esters of alkylphosphonates (see, for example, N. Mongelli *et al.*, Synthesis, 310, 1988) or with esters of acetic acid (according to D.H. Harris *et al.*, Tetrah. Lett., 28, 2837, 1987).

For the preparation of enolates of formula Va, and more generally for the procedure of acylation of the cyclic alkylidenesters of malonic acid (also known as Meldrum acids) with the activated species of a carboxyl of formula IV, the method described by Y. Oikawa *et al.*, J. Org. Chem., 43, 2087 (1978), R.P. Houghton and D.J. Lapham, Synthesis 451 (1982) and C.C. Chan and X. Hung, *ibidem*, 452 (1982) is used.

The preparation of dialkoxyposphonoacetic acids and that of their esters are exemplified in US 4151172 (April 24, 1979), or described by R.A. Malévannaya *et al.*, in Zh. Obshch. Khim. 41, 1426 (1971).

- Specific examples of the compounds of the invention are:
- methyl (R)(-)-4-[(4'-isobutyl)phenyl]-3-oxopentanoate;
 - methyl (S)(+)-4-[(4'-isobutyl)phenyl]-3-oxopentanoate;
 - (R,S) 4-[(4'-isobutyl)phenyl]-3-oxopentanoic acid;
 - methyl (R)(-)-4-[(3'-benzoyl)phenyl]-3-oxopentanoate;
 - (R)(-)-3-[(4'-isobutyl)phenyl]butan-2-one;
 - (S)(+)-3-[(4'-isobutyl)phenyl]butan-2-one;
 - (R)(-)-3-[(3'-benzoyl)phenyl]butan-2-one;
 - (R)(-)-dimethyl 3-(4-isobutyl)-2-oxobutan-1-phosphonate;
 - (S)(+)-dimethyl 3-(3'-phenoxy-phenyl)-2-oxo-butyl-1-phosphonate;
 - (R)(-)-2-(4-isobutylphenyl)-pentan-3-one;
 - (S)(+) ethyl-4-[(3'-benzoyl)phenyl]-3-oxopentanoate;
 - (S)(+)-3-[(3'-benzoyl)phenyl]butan-2-one;
 - (R)(-)-2-(4-isobutylphenyl)-4-phenyl-butan-3-one;
 - (R)(-)-2-(4-isobutylphenyl)-5-phenyl-pentan-3-one;
 - (R)(-)-2-(4-isobutylphenyl)-5-(pyrid-3-yl)-pentan-3-one;
 - (R)(-) methyl 4-[(4'-benzoyloxy)phenyl]-3-oxopentanoate;
 - (R)(-) methyl-4-[(4'-isopropylsulfonyloxy)phenyl]-3-oxopentanoate;

(R)(-) methyl-4-{[4'-(2"-ethyl)phenylsulfonylamino]phenyl}-3-oxopentanoate;

(R,S) 5-(4'-isobutylphenyl)-hexan-2, 4-dione;

(R,S) 1-phenyl-5-(4'-isobutylphenyl)-2, 4-hexandione;

(R,S) 1-(pyrid-2-yl)-4-(4'-isobutylphenyl)-1, 3-pentadione;

5 (R) (-) 2-(4-isobutylphenyl)-7-*tert*-butoxycarbonylamino-heptan-3-one;

(R,S) 2-(4'-isobutylphenyl)-3-oxo-butyl, methyl-sulfoxide;

(R,S) 2-(3'-benzoylphenyl)-3-oxo-butyl, methyl-sulfoxide;

(R,S) 2-(4'-isobutylphenyl)-3-oxo-butyl, methyl-sulfone;

(R,S) 2-(3'-benzoylphenyl)-3-oxo-butyl, methyl-sulfone;

10 (R,S) 2-(3'-phenoxyphenyl)-3-oxo-butyl, methyl-sulfone;

(R,S) 2-(4'-isobutylphenyl)-3-oxo-butyl, phenyl-sulfone;

(R)(-) 4-(4'-pyridyl)-2-[(4"-isobutyl)phenyl]butan-3-one;

(R)-2-[4-(1-oxo-2-isoindolinyl)phenyl]-3-oxo-valeramide;

(R)-2-[4-(1-oxo-2-isoindolinyl)phenyl]-3-oxo-valeronitrile;

15 (R) (+)-5-[2-(4-isobutyl-phenyl)-propion-1-yl]-2, 2-dimethyl-1, 3-dioxan-4, 6-dione;

(R) (-)-5-[2-(3'-benzoyl-phenyl)-propion-1-yl]-2, 2-dimethyl-1, 3-dioxan-4, 6-dione.

The compounds of formula I are powerful inhibitors of the chemiotaxis of the neutrophils induced by IL-8 and inhibit the amplification of the production of TNF- α stimulated by lipopolysaccharides and by hydrogen peroxide. An exacerbated production of hydrogen peroxide is notoriously the final consequence of the neutrophilic activation consequent upon a chemiotactic stimulus.

20 Examples of β -ketoesters of formula I are methyl R(-)-4-[(4'-isobutyl)phenyl]-3-oxopentanoate and methyl R(-)-4-[(3'-benzoyl)phenyl]-3-oxopentanoate, which, at the concentration of 10^{-8} M, inhibit the chemiotaxis of human neutrophils to an extent higher than 50% as compared to control values.

A typical example of 2-aryl-alkan-3-one is R(-)-3-[(4'-isobutyl)phenyl]butan-2-one for which an IC_{50} of 5.10^{-10} M has been calculated in the same *in vitro* inhibition assay.

For evaluation of the compounds of the invention, polymorphonucleated blood cells were used obtained from heparinized blood of healthy adult volunteers by means of sedimentation on dextran. The mononucleated cells were removed by means of 30 Ficoll/Hypaque, whilst the red blood cells were eliminated by treatment with hypotonic solutions. The cell vitality of the polymorphonucleated leucocytes (PMNs) was calculated.

by means of exclusion with Turk and Trypan Blue whilst after staining with Diff Quinck the percentage of the PM-nucleates on the cytocentrifugate was estimated (for details of the experimental techniques used see W.J. Ming *et al.*, J. Immunol., 138, 1469, 1987).

In each of the *in vitro* experiments, time periods of 10 minutes were used for the incubation of the PMNs with the compounds of the invention, operating at a temperature of 37°C.

In the experiments of chemiotaxis and in those designed for measuring the cytosol levels of the Ca^{2+} ion, human recombinant IL-8 (Pepro Tech.) was used as stimulant: the liophilized protein was dissolved in HBSS (Hank's balanced salts solution) at a concentration of 100 ng/mL and was used after dilution in HBSS down to concentrations of 10 ng/mL in the chemiotaxis experiments and at the concentration of 25-50 ng/mL in the evaluation of the modifications of $[\text{Ca}^{2+}]_i$.

In the chemiotaxis assay (according to W. Falket *et al.*, J. Immunol. Methods, 33, 239, 1980) PVP filters were used having a porosity of 5 μm and a Plexiglas microchamber suitable for making 48 replications. The microchamber consists of a block of Plexiglas containing 48 wells, each having a capacity of 25 μL and is provided with a lid, which in turn contains 48 pores arranged in such a way that, once the lid has been set in place and screwed to the underlying part, it comes to form the top compartments of the microchamber, each having a capacity of 50 μL .

The compounds under study were added at one and the same concentration in the wells of higher level, which contain the suspension of PMNs and in the wells of lower level, which contain the vehicle to which IL-8 (or a different stimulant) has been added or not.

For determination of the cytosol variations of the $[\text{Ca}^{2+}]_i$, the experimental model described by C. Bizzarri *et al.*, (Blood, 86, 2388, 1995) was adopted, using slides containing adhered PMNs, which were fed with 1 μM of Fura-2AM in order to evaluate said variations of $[\text{Ca}^{2+}]_i$ in real time. In turn, cytocentrifugates of PMNs were resuspended in RPMI medium 1640 with 5% of FCS (foetal cow serum) at a concentration of $3 \times 10^6/\text{mL}$ and then plated on round glass slides of a diameter of 25 mm, which were placed in an incubator for 30 min at 37°C. After three consecutive washings with balanced salts solution (BSS) to remove the non-adherent cells, a further incubation was performed for the set of adherent cells for a maximum of 4 hours before feeding with Fura-2AM.

The compounds of the invention prevent the increase in the intracellular concentration of Ca^{2+} induced by IL-8.

The compounds of the invention are characterized by their capacity for inhibiting *in vitro* the chemiotaxis of the human PMN leucocytes (PMNs) stimulated by interleukin 8, also

5 known as "monocyte-derived neutrophil-activating protein" (NAP/IL-8 or more simply IL-8). Said inhibition is dose-dependent, with values of IC_{50} (dose inhibiting 50% of the

effect) in the 10^{-7} to 10^{-9} -M range; the inhibiting effect is selective and specific in regard to the chemiotactic stimulus induced by IL-8. Concentrations higher by one or two orders

of magnitude are needed to inhibit the chemiotaxis stimulated *in vitro* by other

10 chemiotactic factors (C5a, formylpeptides of bacterial origin or synthetic origin, such as f-LMP). The specificity of the compounds of the invention is moreover demonstrated by their capacity to inhibit the increase in the intracellular concentration $[\text{Ca}^{2+}]_i$ in human

PMNs, an increase that is associated to the activation of the human PMNs themselves by IL-8 [J.H. Liu *et al.*, J. Infect. Dis., 166, 1089 (1992)].

15 Independently of the absolute configuration, the compounds of the invention are without significant effects on cyclooxygenasis and on the production of PG.

In fact, in murine macrophages stimulated by LPS (1 $\mu\text{g}/\text{mL}$), the compounds of the invention (evaluated in the range of concentration of 10^{-5} to 10^{-7} M) show an inhibition of

the production of PGE_2 which, albeit frequently at the limit of statistical significance, is

20 never higher than 10 to 15% of the basal value.

The above minor inhibition of the synthesis of PGE_2 involves the advantage, unlike what occurs for certain 2-aryl-propionic acids, of not constituting a stimulus that is likely to

amplify the synthesis of $\text{TNF-}\alpha$ by the murine macrophages themselves (once they have been stimulated by LPS). The amplification of the synthesis of $\text{TNF-}\alpha$ is considered to

25 concur, in turn, in amplifying the activation and chemiotaxis of the neutrophils and the synthesis of IL-8. On the other hand, these effects of non-amplification of the synthesis of $\text{TNF-}\alpha$ are shown also in regard to the synthesis of $\text{TNF-}\alpha$ stimulated by hydrogen peroxide.

It is known that interleukin 8 (IL-8) and the correlated cytokines are the most important

30 modulators of the infiltration of the neutrophils in diseases such as psoriasis (B.J. Nickoloff *et al.*, Am. J. Pathol., 138, 129, 1991), rheumatoid arthritis (M. Selz *et al.*, J. Clin. Invest. 87, 463, 1991), ulcerative colitis (Y.R. Mahkila *et al.*, Clin. Sci., 82, 273,

Nickoloff *et al.*, Am. J. Pathol., 138, 129, 1991), rheumatoid arthritis (M. Selz *et al.*, J. Clin. Invest. 87, 463, 1991), ulcerative colitis (Y.R. Mahkla *et al.*, Clin. Sci., 82, 273, 1992), acute respiratory distress syndrome (ARDS), idiopathic fibrosis (P.C. Carré *et al.*, J. Clin. Invest., 88, 1802, 1991 and E.J. Miller *et al.*, Am. Rev. Respir. Dis., cited above),
 5 glomerulonephritis (T. Wada *et al.*, J. Exp. Med., 180, 1135, 1994) and bolloous pemphigo. The compounds of the invention are then used for the treatment of said diseases, conveniently formulated in pharmaceutical compositions using conventional techniques and excipients.

The compounds of the invention are also conveniently used for the prevention and the
 10 treatment of damages caused by ischemia and reperfusion, in particular in connection with organ transplantation.

The compositions of the invention can be administered via intramuscular injection, via intravenous route, as a bolus, in preparations for dermatological use (creams, lotions, sprays and ointments), as well as via oral route in the form of capsules, tablets, syrup,
 15 controlled-release formulations, and the like.

The mean daily dosage will depend upon various factors, such as the severity of the illness and the conditions of the patient (age, sex and weight). The dose will vary generally from one mg or a few mg up to 1500 mg of the compounds per day, optionally divided into multiple administrations. Higher dosages, as well as more prolonged treatment times, can
 20 be administered also by virtue of the low toxicity of the compounds of the invention.

The following examples are provided by way of illustration of the invention. The examples are not construed to be viewed as limiting the scope of the invention.

Example 1

(R) (-)-3-[(4'-isobutyl)phenyl]butan-2-one

25 (R) (-)-ibuprofen (2g, 9.69 mmol) is dissolved in thionyl chloride (4 mL), and the solution obtained is refluxed for 4 hours.

After cooling to room temperature, the solvent is evaporated at reduced pressure, and the excess of thionyl chloride is eliminated by dissolving the residue twice with dioxane and evaporating the solvents at a high vacuum. The oily yellow residue (2.34 g; 9.34 mmol)
 30 thus obtained, is dissolved in dry dichloromethane (3 mL) and added, by means of slow dripping and in an inert-gas atmosphere, to a solution of 2, 2-dimethyl-1, 3-dioxan-2, 5-dione (Meldrum's acid) (1.35 g; 9.34 mmol) and pyridine (1.83 mL; 22.9 mmol) in dry dichloromethane (7.5 mL) previously cooled to 0 - 5°C with a water/ice bath. Once the

additions are completed, the product is left for one hour at this temperature and then for another hour at room temperature. The mixture diluted with dichloromethane is partitioned with a 2N HCl and crushed ice, under vigorous stirring for 30 min. After separation of the phases, the organic phase, washed with 2N HCl (2x10 mL) and with a saturated solution of NaCl, is dried on Na₂SO₄. After evaporation of the solvents at reduced pressure, 2.69 g of R(+)-5-[2-(4-isobutyl-phenyl)-propion-1-yl]-2, 2-dimethyl-1, 3-dioxan-4, 6-dione is obtained as an oil. ($[\alpha]_D = +61.7^\circ$; $c = 1\%$ CH₂Cl₂) which, without further purifications, is dissolved in dioxane (10 mL). Glacial acetic acid (0.84 mL) and water (0.13 mL) are added; and the resulting solution is heated to the reflux temperature for 3 hours. After cooling and evaporation of the solvents, the residue is purified by means of flash chromatography (eluent: n-hexane/ethyl ether 9:1) to yield (R) (-)-3-[(4'-isobutyl)phenyl]butan-2-one as a pale yellow oil (0.97 g; 4.75 mmol). $[\alpha]_D = -216.1^\circ$ ($c=1$; CH₃CH₂OH); ¹H-NMR (CDCl₃): δ 6.95 (s, 4H); 3.61 (q, 1H, J=8Hz); 2.3 (d, 3H, J=7Hz); 1.93 (s, 3H); 1.75 (m, 1H); 1.26 (d, 2H, J=8Hz); 0.85 (d, 6H, J=7Hz).

Example 2

(S) (+)-3-[(4'-isobutyl)phenyl]butan-2-one;

(R) (-)-3-[(3'-benzoyl)phenyl]butan-2-one;

Following the procedure of Example 1, using 0.3 g (1.33 mmol) of S (+)-ibuprofen, S(+)-3-[(4'-isobutyl)phenyl]butan-2-one is obtained (0.13 g, 0.63 mmol) as a pale yellow oil;

$[\alpha]_D = +210.5$ ($c=1$; CH₃CH₂OH); ¹H-NMR (CDCl₃): δ 7.10 (s, 4H); 3.75 (q, 1H, J=8Hz); 2.45 (d, 3H, J=7Hz); 2.05 (s, 3H); 1.85 (m, 1H); 1.32 (d, 2H, J=8Hz); 0.92 (d, 6H, J=7Hz).

Likewise, starting from 0.74 g (2.9 mmol) of (R) (-)-ketoprofen, 0.46 g (1.79 mmol) of R(-)-3-[(3'-benzoyl)phenyl]butan-2-one are obtained as a yellow oil; $[\alpha]_D = -103^\circ$

($C=1$; CH₃OH); ¹H-NMR (CDCl₃): δ 7.85 (m, 2H); 7.75 (m, 2H); 7.60 (m, 1H); 7.55-7.40 (m, 4H); 3.85 (q, 1H, J=8Hz); 2.1 (s, 3H); 1.45 (d, 3H, J=8Hz).

Example 3

methyl (R) (-)-4-[(4'-isobutyl)phenyl]-3-oxopentanoate

4-[(4'-isobutyl)phenyl]-3-oxopentanoic acid

(R) (-)-ibuprofen (1.2 g, 5.8 mmol) is dissolved in dioxane (5 mL); thionyl chloride

(2.36 mL) is added and the solution obtained is refluxed and left to reflux for 3 hours.

After cooling to room temperature, the solvent is evaporated at reduced pressure, and the excess of thionyl chloride is eliminated, dissolving the residue twice with dioxane and

evaporating the solvents under high vacuum. An oily yellow residue (1.3 g; 5.79 mmol) is obtained, which is dissolved in dry dichloromethane (2 mL) and added, by means of slow dripping and in an inert atmosphere, to a solution of 2, 2-dimethyl-1,3-dioxan-2,5-dione (Meldrum's acid) (0.83 g; 5.79 mmol) and pyridine (1.12 mL; 14 mmol) in dry dichloromethane (5 mL) previously cooled to $T=+5^{\circ}\text{C}$ with a water/ice bath. Once the additions are completed, the mixture is left for one hour at this temperature and then for another hour at room temperature. The mixture, diluted with dichloromethane is repartitioned with a 2N solution of HCl and crushed ice, under vigorous stirring for approximately 30 min. After separation of the phases, the organic phase, washed with 2N HCl (2 x 10 mL) and with a saturated solution of NaCl, is dried on Na_2SO_4 . After evaporation of the solvent at reduced pressure, the residue of (R) (+)-5-[2-(4-isobutylphenyl)-propion-1-yl]-2, 2-dimethyl-1, 3-dioxan-4, 6-dione ($[\alpha]_D^{25}=+62^{\circ}$; $c=1.1\%$ CH_2Cl_2) without further purifications, is dissolved in methanol (14 mL); the solution is reheated to reflux for 3 hours. After cooling and evaporation of the solvent, the residue is purified by means of flash chromatography (eluent: n-hexane/ethyl ether 8:2) to yield pure methyl ester of (R) (-)-4-[(4'-isobutyl)phenyl]-3-oxopentanoic acid as a colourless oil (0.6 g; 2.28 mmol); $[\alpha]_D^{25}=-192.5^{\circ}$ ($c=1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3): δ 7.1 (s, 4H); 3.88 (q, 1H, $J=8\text{Hz}$); 3.67 (s, 3H); 3.47-3.28 (q, 2H, $J=8\text{Hz}$); 2.45 (d, 2H, $J=8\text{Hz}$); 1.85 (m, 1H); 1.40 (d, 3H, $J=8\text{Hz}$); 0.95 (d, 6H, $J=7\text{Hz}$).

To a solution in methanol (2 mL) of 0.15 g (0.57 mmol) of said ester is added a solution of 1N NaOH (1 mL); and the mixture is stirred at room temperature overnight. The solvents are then evaporated at reduced pressure; the residue is dissolved with water (3 mL), and 2N HCl is added by dripping up to pH=1 the mixture is then extracted with ethyl ether (3x10 mL); the organic phase is then washed with a saturated solution of NaCl (10 mL), dried on Na_2SO_4 , and evaporated at reduced pressure to yield 0.12 g (0.48 mmol) of pure (+) 4-[(4'-isobutyl)phenyl]-3-oxopentanoic acid, as a colourless oil; $^1\text{H-NMR}$ (CDCl_3): δ 7.1 (m 4H); 3.88 (q, 1H, $J=8\text{Hz}$); 3.45 (m, 2H); 2.48 (d, 2H, $J=8\text{Hz}$); 1.90 (m, 1H); 1.45 (d, 3H, $J=8\text{Hz}$); 0.90 (d, 6H, $J=7\text{Hz}$).

Example 4

30 methyl (R) (-)-4-[(3'-benzoyl)phenyl]-3-oxopentanoate.

By substituting the R-ibuprofen with 0.74 g (2.9 mmol) of R(-)-ketoprofen in the process of Example 3, 0.81 g of (R) (-)-5-[2-(3'-benzoyl-phenyl)-propion-1-yl]-2,2-dimethyl-1,3-

dioxan-4,6-dione are obtained ($[\alpha]_D = -39.5^\circ$; $c = 1\%$ CH_2Cl_2), which, by boiling in methanol yields, after purification by flash chromatography (eluent: n-hexane/ethyl acetate 8:2), 0.49 g (1.56 mmol) of pure methyl (R) (-)-4-[(3'-benzoyl)phenyl]-3-oxopentanoate as a colourless oil, $[\alpha]_D = -135^\circ$ ($c = 1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3): δ 7.85-7.40 (m, 9H); 4.0 (q, 1H, $J = 8\text{Hz}$); 3.70 (s, 3H); 3.50-3.30 (q, 2H, $J = 8\text{Hz}$); 1.45 (d, 3H, $J = 8\text{Hz}$).

Example 5

(S) (+) ethyl-4-[(3'-benzoyl)phenyl]-3-oxopentanoate

(S) (+)-3-[(3'-benzoyl)phenyl]butan-2-one

At room temperature, in an inert-gas atmosphere and under stirring, to a suspension of magnesium ethylate (0.57 g) in 6 mL of anhydrous THF a solution of mono-ethylester malonic acid (1.3 g) in 3 mL of THF is added. After complete solution of the reagents, to the mixture of the complex magnesium-malonic ethylester, by rapid dripping, a solution of S(+) 2-(3-benzoylphenyl) propionylimidazolidine (0.83 g) in 10 mL of anhydrous THF is added, prepared *in situ* by addition of 0.43 g of 1,1'-carbonyldiimidazole to a solution of S(+) 2-(3-benzoylphenyl) propionic acid (0.66 g) in THF. The mixture is stirred for 4 hours, then is acidified by addition of 50% aqueous AcOH (1.2 mL) and is concentrated under vacuum at a small volume and diluted with water. After repeated extractions with ethyl acetate, the organic phases are combined, rinsed with a saturated solution of NaCl, dried on sodium sulfate, and evaporated to dryness to yield, after purification on silica gel, 0.82 g of ethyl (S) (+)-4-[(3'-benzoyl)phenyl]-3-oxopentanoate; $[\alpha]_D = +129^\circ$ ($c = 1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3): δ 7.82-7.45 (m, 9H); 4.1 (q, 1H, $J = 8\text{Hz}$); 3.75 (s, 3H); 3.50-3.25 (q, 2H, $J = 8\text{Hz}$); 1.48 (d, 3H, $J = 8\text{Hz}$).

According the same described procedure and starting from the corresponding arylpropionic acids the following 3-oxoesters have been synthesised:

(R)(-) methyl 4-[(4'-benzoyloxy)phenyl]-3-oxopentanoate

$^1\text{H-NMR}$ (CDCl_3): δ 8.02 (m, 2H); 7.51 (m, 1H); 7.35 (m, 2H); 7.27 (s, 1H); 7.22 (m, 2H); 3.85 (m, 2H); 3.74 (s, 3H); 3.42-3.37 (q, 2H, $J = 8\text{Hz}$); 2.78 (q, 2H, $J = 8\text{Hz}$); 1.25 (t, 3H, $J = 8\text{Hz}$).

(R)(-) methyl-4-[(4'-isopropylsulfonyloxy)phenyl]-3-oxopentanoate

$[\alpha]_D = -184.2^\circ$ ($c = 1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3): δ 7.32 (d, 2H, $J = 7\text{Hz}$); 7.21 (d, 2H, $J = 7\text{Hz}$); 4.1 (q, 1H, $J = 8\text{Hz}$); 3.81 (m, 1H); 3.70 (s, 3H); 3.50-3.30 (q, 2H, $J = 8\text{Hz}$); 1.75 (d, 6H, $J = 7\text{Hz}$); 1.45 (d, 3H, $J = 8\text{Hz}$).

(R)(-) methyl-4-{[4'-(2"-ethyl)phenylsulfonylamino]phenyl}-3-oxopentanoate

$[\alpha]_D = -81.3^\circ$ ($c=1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3): δ 7.32 (d, 2H, $J=7\text{Hz}$); 7.20 (m, 6H); 6.84 (bs, 1H, SO_2NH); 4.05 (q, 1H, $J=8\text{Hz}$); 3.72 (s, 3H); 3.55-3.35 (q, 2H, $J=8\text{Hz}$); 2.75 (q,

2H, $J=8\text{Hz}$); 1.45 (d, 3H, $J=8\text{Hz}$); 1.22 (t, 3H, $J=8\text{Hz}$). A solution of 0.4 g of the compound

in 1.5 mL of dimethylsulfoxide, to which 2 drops of a saturated aqueous solution of NaCl are added, is heated for 4 hours, under stirring, in a bath at $140-145^\circ\text{C}$; after cooling and

dilution with water, the mixture is extracted repeatedly with ethyl acetate. From the combined organic phases, after the usual processing, an oily residue is obtained which,

after purification by flash chromatography, yields 0.24 g of S (+)-3-[(3'-

benzoyl)phenyl]butan-2-one as a yellow oil; $[\alpha]_D = +101^\circ$ ($c=1$; CH_3OH); $^1\text{H-NMR}$

(CDCl_3): δ 7.83 (m, 2H); 7.77 (m, 2H); 7.65 (m, 1H); 7.50-7.45 (m, 4H); 3.85 (q, 1H, $J=8\text{Hz}$); 2.3 (s, 3H); 1.40 (d, 3H, $J=8\text{Hz}$).

Example 6

(R)(-)dimethyl 3-(4-isobutylphenyl)-2-oxobutan-1-phosphonate

A solution of (R)(-)ibuprofen (3.45 g) in ethyl ether, cooled to 5°C , is treated, dropwise, with a 0.6 M solution of diazomethane in ethyl ether, up to a persistent yellow colour. The solvent is removed under vacuum; the residual oil is purified by flash chromatography to yield 3.3 g of methyl (R)(-) 2-(4'-isobutylphenyl)-propionate.

Alternatively, 2.6 g of carbonyldiimidazole are added under stirring to a solution of R(-) ibuprofen (3.45 g) in 10 mL of THF. The mixture is stirred for 1 h, the solvent is evaporated under vacuum, and the residual oil is purified by flash chromatography to yield 4.05 g of (R)(-) 2-(4'-isobutylphenyl)-propionylimidazolid.

In an inert-gas atmosphere, a solution of butyl lithium (1.56 M; 13.3 mL, 0.027 mol) in hexane is added dropwise to a solution of dimethyl methylphosphonate (3.69 g; 0.03 mol) in anhydrous THF (10 mL) cooled to -70°C . The mixture is stirred for 15 min before addition, dropwise, of a solution in anhydrous THF (10 mL) of methyl ester or of imidazolid, prepared as previously described.

Upon completion of the dripping step, the reaction mixture is kept, under stirring, for 1 h at -70°C and then for 1 h at room temperature. The mixture is then cooled to -10°C , and

1.8 mL of glacial acetic acid is added dropwise. The solvent is removed under vacuum, the residue is diluted with water, and the mixture is repeatedly extracted with dichloromethane

(4x50 mL). The organic extracts are dried on sodium sulfate; after evaporation of the solvent, the residue is purified on silica gel, eluted with AcOEt to yield, as a colourless oil, 3.02 g of (R) (-)-dimethyl 3-(4-isobutyl)-2-oxobutan-1-phosphonate.

$[\alpha]_D = -171^\circ$ ($c=1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3): δ 7.03 (s, 4H); 4.1-3.9 (dd, 2H, $J_1=15\text{Hz}$, $J_2=8\text{Hz}$); 3.8 (s, 3H); 3.70 (m, 1H); 3.65 (s, 3H); 2.55 (d, 2H, $J=8\text{Hz}$); 1.75 (m, 1H); 1.50 (d, 3H, $J=8\text{Hz}$); 0.85 (d, 6H, $J=7\text{Hz}$).

Example 7

(R) (-) 2-(4-isobutylphenyl)-7-*tert*-butoxycarbonylamino-heptan-3-one.

A solution of ethyl 5-*tert*-butoxycarbonylamino-2-ethoxycarbonyl-pentanoate (WO 94/10127) (1.59 g) in 3 mL of methanol is added to 8 mL of a 0.63 N solution of $\text{LiOH}\cdot\text{H}_2\text{O}$ in water/methanol (1:1); the mixture is stirred for 12 h at room temperature. The mixture is diluted with 10 mL of a saturated solution of monosodium phosphate, and the excess of methanol is removed under vacuum. The mixture is extracted with ethyl acetate (2x10 mL); from the organic extracts, combined and dried on sodium sulfate, by evaporation of the solvent 1.4 g (4.8 mmol) of 5-*tert*-butoxycarbonylamino-2-ethoxycarbonyl-pentanoic acid are obtained.

To a solution of the acid (2.4 mmol) in 8 mL of anhydrous THF 0.27 g (2.4 mmol) of commercially available magnesium ethylate is then added, and the suspension is stirred at room temperature up to complete dissolution of the reagents to form the magnesium complex.

Then a solution of 0.3 g of (R) (-) 2-(4'-isobutylphenyl)-propionylimidazolidine is added, and the mixture is stirred for 4 h at room temperature. The mixture is acidified by addition of a few mL of 50% aqueous AcOH, and the solvent is evaporated under vacuum. The residue is repartitioned between water and ethyl acetate to yield, after the usual processing, crude product (0.42 g) of ethyl (R,S)-2-[R-2-(4-isobutyl)-propionyl]-5-*tert*-butoxycarbonylamino-pentanoate, which is purified by flash chromatography.

A solution of 0.15 g of β -ketoester in $\text{DMSO}/\text{NaCl}/\text{H}_2\text{O}$ is then dealkoxydecarboxylated by heating to 135-145°C to yield 0.08 g of (R) (-) 2-(4-isobutylphenyl)-7-*tert*-butoxycarbonylamino-heptan-3-one.

$[\alpha]_D = -25$ ($c=1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3): δ 7.25 (s, 4H); 6.35 (bs, 1H, CONH); 3.70 (q, 1H, $J=8\text{Hz}$); 3.40 (m, 2H); 2.45 (d, 2H, $J=7\text{Hz}$); 2.31 (m, 2H); 1.85 (m, 1H); 1.75-1.62 (m, 4H); 1.60 (d, 3H, $J=7\text{Hz}$); 1.45 (s, 9H); 0.94 (d, 6H, $J=7\text{Hz}$).

Example 8

Following the procedure of Example 7, but using as a starting material a monoester of a substituted malonic acid chosen in the group of:

methyl 2-carboxy-propionate;

5 methyl 2-carboxy-2-phenyl acetate;

methyl 2-carboxy-3-phenyl propionate;

methyl 2-carboxy-3-(pyrid-3-yl) propionate;

methyl 2-carboxy-3-cyclopentyl propionate;

the following β -ketoesters were obtained:

10 methyl(R', S')-2-[R-2-(4-isobutylphenyl)-propionyl] propionate;

methyl(R', S')-2-[R-2-(4-isobutylphenyl)-propionyl]-2-phenyl acetate;

methyl(R', S')-2-[R-2-(4-isobutylphenyl)-propionyl]-3-phenyl propionate;

methyl(R', S')-2-[R-2-(4-isobutylphenyl)-propionyl]-3-(pyrid-3-yl) propionate;

methyl(R', S')-2-[R-2-(4-isobutylphenyl)-propionyl]-3-cyclopentyl propionate;

15 to obtain, after decarboxylation in DMSO/NaCl, the corresponding ketones:

R(-) 2-(4-isobutylphenyl)-pentan-3-one

$[\alpha]_D = -36$ ($c=1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3); δ 7.20 (d, 2H, $J=7\text{Hz}$); 7.10 (d, 2H, $J=7\text{Hz}$); 3.70 (q, 1H, $J=8\text{Hz}$); 2.47 (d, 2H, $J=7\text{Hz}$); 2.40 (q, 2H, $J=7\text{Hz}$); 1.82 (m, 1H); 1.55 (d, 3H, $J=7\text{Hz}$); 0.98 (d, 3H, $J=7\text{Hz}$); 0.94 (d, 6H, $J=7\text{Hz}$).

20 R(=) 2-(4-isobutylphenyl)-4-phenyl-butan-3-one

$[\alpha]_D = -48.5$ ($c=1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3); δ 7.35-7.18 (m, 5H); 7.15 (d, 2H, $J=7\text{Hz}$); 7.05 (d, 2H, $J=7\text{Hz}$); 3.72 (q, 1H, $J=8\text{Hz}$); 3.65 (s, 2H); 2.42 (d, 2H, $J=7\text{Hz}$); 1.80 (m, 1H); 1.60 (d, 3H, $J=7\text{Hz}$); 0.93 (d, 6H, $J=7\text{Hz}$).

R(-) 2-(4-isobutylphenyl)-5-phenyl-pentan-3-one

25 $[\alpha]_D = -40$ ($c=1.5$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3); δ 7.37-7.20 (m, 5H); 7.10 (d, 2H, $J=7\text{Hz}$); 7.00 (d, 2H, $J=7\text{Hz}$); 3.70 (q, 1H, $J=8\text{Hz}$); 2.88 (m, 2H); 2.75 (m, 2H); 2.45 (d, 2H, $J=7\text{Hz}$); 1.82 (m, 1H); 1.63 (d, 3H, $J=7\text{Hz}$); 0.95 (d, 6H, $J=7\text{Hz}$). R(-) 2-(4-isobutylphenyl)-5-(pyrid-3-yl)-pentan-3-one

30 $[\alpha]_D = -89$ ($c=1$; CH_3OH); $^1\text{H-NMR}$ (CDCl_3); δ 8.62 (m, 2H); 7.80 (m, 1H); 7.35 (m, 1H); 7.15 (d, 2H, $J=7\text{Hz}$); 7.08 (d, 2H, $J=7\text{Hz}$); 5.35 (t, 2H, $J=8\text{Hz}$); 5.05 (t, 2H, $J=8\text{Hz}$); 3.72 (q, 1H, $J=8\text{Hz}$); 2.42 (d, 2H, $J=7\text{Hz}$); 1.80 (m, 1H); 1.63 (d, 3H, $J=7\text{Hz}$); 0.94 (d, 6H, $J=7\text{Hz}$).

Example 9

(R,S) 1-phenyl-4-(4'-isobutylphenyl)-1, 3-pentadione

A suspension of 0.55g of magnesium ethylate in a solution of 1.61g of benzoylacetic acid is stirred at room temperature, in an inert-gas atmosphere, up to total dissolution of the reagents. A solution of 0.6g of (R,S)-2-(4'-isobutylphenyl)-propionylimidazolidine is added, and stirring is continued overnight at room temperature. The mixture is brought to neutrality by addition of a few drops of 50% aqueous AcOH, and is then evaporated to dryness under vacuum. The residue is repartitioned between water and ethyl acetate. The combined organic phases are dried on sodium sulfate, and evaporated to dryness. The residue is purified by flash chromatography to obtain 0.78g of (R,S) 1-phenyl-4-(4'-isobutylphenyl)-1, 3-pentadione.

¹H-NMR (CDCl₃); δ 7.90 (m, 2H); 7.65 (m, 1H); 7.52 (m, 2H); 7.20 (d, 2H, J=7Hz); 7.12 (d, 2H, J=7Hz); 3.77 (s, 2H); 3.68 (q, 1H, J=8Hz); 2.41 (d, 2H, J=7Hz); 1.82 (m, 1H); 1.60 (d, 3H, J=7Hz); 0.95 (d, 6H, J=7Hz).

Example 10

Following the procedure of Example 9, and using a β-ketoacid chosen in the group of acetylacetic acid, 4-phenyl-3-oxo-butyrric acid or nicotinoylacetic acid, in place of benzoylacetic acid, the following are obtained:

(R,S) 5-(4'-isobutylphenyl)-hexan-2, 4-dione

¹H-NMR (CDCl₃); δ 7.20 (d, 2H, J=7Hz); 7.12 (d, 2H, J=7Hz); 3.75 (s, 2H); 3.65 (q, 1H, J=8Hz); 2.40 (d, 2H, J=7Hz); 2.10 (s, 3H); 1.82 (m, 1H); 1.62 (d, 3H, J=7Hz); 0.94 (d, 6H, J=7Hz).

(R,S) 1-phenyl-5-(4'-isobutylphenyl)-2, 4-hexandione

¹H-NMR (CDCl₃); δ 7.35-7.20 (m, 5H); 7.15 (d, 2H, J=7Hz); 7.05 (d, 2H, J=7Hz); 3.75 (s, 2H); 3.68 (q, 1H, J=8Hz); 3.63 (s, 2H); 2.41 (d, 2H, J=7Hz); 1.80 (m, 1H); 1.64 (d, 3H, J=7Hz); 0.95 (d, 6H, J=7Hz).

(R,S) 1-(pyrid-2-yl)-4-(4'-isobutylphenyl)-1, 3-pentadione

¹H-NMR (CDCl₃); δ 8.60 (m, 2H); 7.81 (m, 1H); 7.37 (m, 1H); 7.18 (d, 2H, J=7Hz); 7.10 (d, 2H, J=7Hz); 3.70 (q, 1H, J=8Hz); 3.65 (s, 2H); 2.40 (d, 2H, J=7Hz); 1.81 (m, 1H); 1.65 (d, 3H, J=7Hz); 0.95 (d, 6H, J=7Hz).

Example 11

(R,S) 2-(4'-isobutylphenyl)-3-oxo-butyl, methyl-sulfoxide

A solution of sodium hydride (21 mmol) in dry methylsulfoxide (5 mL) is heated at 60°C, in an inert-gas atmosphere, for 1 h. A solution of 2.2 g (10 mmol) of methyl 2-(4'-isobutylphenyl)-propionate in dry methylsulfoxide is dropped, and stirring is continued for 2 h at 60 °C. The mixture is cooled at room temperature, brought to neutrality by addition of AcOH (0.25 mL), and diluted with diethyl ether. 1N HCl is added until pH=2 and CH₂Cl₂ and water are added. The two phases are debated and separated; the combined organic phases are dried on sodium sulfate, and evaporated to dryness. The residue is purified by flash chromatography to obtain 0.350 g of (R,S) 2-(4'-isobutylphenyl)-3-oxo-butyl, methyl-sulfoxide.

¹H-NMR (CDCl₃); δ 7.14 (s, 4H); 3.85 (m, 2H); 3.52 (m, 1H); 2.65 + 2.54 (s, 3H); 2.47 (d, 2H, J=7Hz); 1.87 (m, 1H); 1.43 (d, 3H, J=7Hz); 0.92 (d, 6H, J=7Hz).

According the same above described procedure and using the corresponding methyl ester of ketoprofen the following compound is obtained:

(R,S) 2-(3'-benzoylphenyl)-3-oxo-butyl, methyl-sulfoxide

¹H-NMR (CDCl₃); δ 7.85-7.60 (m, 4H); 7.52-7.40 (m, 5H); 3.80 (m, 2H); 3.55 (m, 1H); 2.62 + 2.55 (s, 3H); 2.47 (d, 2H, J=7Hz); 1.85 (m, 1H); 1.40 (d, 3H, J=7Hz); 0.94 (d, 6H, J=7Hz).

According the same above described procedure and using the methyl ester of the corresponding arylpropionic acids and methylsulfone (or phenylsulfone) instead of

methylsulfoxide, the following compounds are obtained:

(R,S) 2-(4'-isobutylphenyl)-3-oxo-butyl, methyl-sulfone

¹H-NMR (CDCl₃); δ 7.18 (s, 4H); 4.18 (m, 2H); 3.90 (m, 1H); 3.10 (s, 3H); 2.40 (d, 2H, J=7Hz); 1.80 (m, 1H); 1.52 (d, 3H, J=7Hz); 0.94 (d, 6H, J=7Hz).

(R,S) 2-(3'-benzoylphenyl)-3-oxo-butyl, methyl-sulfone

¹H-NMR (CDCl₃); δ 7.85-7.60 (m, 4H); 7.52-7.40 (m, 5H); 4.20 (m, 3H); 3.95 (m, 1H); 3.18 (s, 3H); 1.55 (d, 3H, J=7Hz).

(R,S) 2-(3'-phenoxyphenyl)-3-oxo-butyl, methyl-sulfone

¹H-NMR (CDCl₃); δ 7.25-7.38 (m, 2H); 7.15-7.05 (m, 2H); 7.02 (m, 2H); 6.70-6.60 (m, 2H); 6.55 (s, 1H); 4.21 (m, 3H); 4.15 (m, 1H); 3.20 (s, 3H); 1.58 (d, 3H, J=7Hz).

(R,S) 2-(4'-isobutylphenyl)-3-oxo-butyl, phenyl-sulfone

¹H-NMR (CDCl₃); δ 8.05 (m, 2H); 7.75 (m, 1H); 7.60 (m, 2H); 7.15 (s, 4H); 4.15 (m, 2H); 3.95 (m, 1H); 2.40 (d, 2H, J=7Hz); 1.80 (m, 1H); 1.52 (d, 3H, J=7Hz); 0.94 (d, 6H, J=7Hz).

Example 12

5 (R)(-)-4-(4'-pyridyl)-2-[(4"-isobutyl)phenyl]butan-3-one

Diisopropylamine (0.17 mL; 1.21 mmol) and sodium hydride (60% in mineral oil, 0.106 mg; 2.66 mmol) are dissolved in dry THF (20 mL) under nitrogen atmosphere; 4-pyridylacetic acid (0.166 g; 1.21 mmol) is added portionwise to the mixture and the mixture refluxed for 15'. After cooling at T=0°-4°C by an ice-water bath, butyllithium (1.6 M in hexanes, 0.75 mL; 1.21 mmol) is added to the mixture and, after 30', a solution of R(-)-2-(4'-isobutylphenyl)propionyl chloride (0.27 g; 1.21 mmol) in dry THF (10 mL) is added dropwise. At the end of the adding, the ice-water bath is removed and the solution is left under stirring overnight at room temperature. The solvent is evaporated under reduced pressure and the residue is diluted with diethyl ether (20 mL), washed with water (3 x 15 mL), dried over Na₂SO₄ and evaporated under vacuum to give a dark red oil which is dissolved in 6N HCl (5 mL). The solution is heated at reflux for 2 hours; after cooling at room temperature the solvents are evaporated under vacuum and the residue is purified by flash chromatography to give pure R(-)-4-(4'-pyridyl)-2-[(4"-isobutyl)phenyl]butan-3-one (0.25 g; 0.88 mmol) as pale yellow oil.

20 $[\alpha]_D = -148^\circ$ (c=1; CHCl₃). ¹H-NMR (CDCl₃); δ 8.54 (m, 2H); 7.15-6.90 (m, 6H); 3.85 (m, 1H); 3.72 (q, 2H, J=8 Hz); 2.51 (d, 3H, J=8Hz); 1.87 (m, 1H); 1.45 (d, 2H, J=7Hz); 0.92 (d, 6H, J=7Hz).

Example 13

(S) (+) dimethyl 3-(3'-phenoxy-phenyl)-2-oxo-butan-1-phosphonate.

25 Carbonyldiimidazole (0.18 g) is added to a solution of (S) 2-(3'-phenoxy-phenyl)-propionic acid (0.24 g) in anhydrous THF (5 mL) and is stirred for at least 1 h to form the corresponding imidazolide (Sol. A).

Separately, to a solution of dimethylphosphonoacetic acid (1.7 g) in anhydrous THF (25 mL) magnesium ethylate (0.5 g) is added, and the mixture is stirred for 3 h prior to rapid addition of the solution of imidazolide (Sol. A). The reaction mixture is stirred for 30 18 h at 25°C.

After evaporation of the solvent under vacuum, the residue is partitioned between ethyl acetate and 0.5 N aqueous HCl. The organic phase is washed with water, 5% aqueous sodium bicarbonate and water up to neutrality. After drying on Na₂SO₄, evaporation of the solvent and purification of the residue by flash chromatography on silica gel, 0.26 g of (S)

- 5 (+) dimethyl 3-(3'-phenoxy-phenyl)-2-oxo-butyl-1-phosphonate are obtained.
 $[\alpha]_D = +125^\circ$ (c=1; CH₃OH); ¹H-NMR (CDCl₃); δ 7.25-7.32 (m, 2H); 7.15-7.05 (m, 2H); 7.03 (m, 2H); 6.70-6.65 (m, 2H); 6.50 (s, 1H); 4.15-3.9 (dd, 2H, J₁=15Hz, J₂=8Hz); 3.82 (s, 3H); 3.70 (m, 1H); 3.62 (s, 3H); 1.50 (d, 3H, J=8Hz).

Example 14

- 10 (R) 2-[4-(1-oxo-2-isoindolinyl)phenyl]-3-oxo-valeramide

Carbonyldiimidazole (1.7 g) is added to a solution of 2.8 g of (R)-indoprofen in 15 mL of (anhydrous) THF, and is stirred for 2 h at room temperature to form the indoprofen imidazolide (Sol. A).

- 15 Separately, magnesium ethylate (2.3 g) is added, under stirring, to a solution of 4.2 g of the monoamide of malonic acid in 15 mL of THF. After the total dissolution of the reagents, the solution of the imidazolide is added, and the mixture is stirred for 24 h at room temperature.

After evaporation of the solvent under vacuum, the residue is divided between ethyl acetate and aqueous 0.5 N HCl. The organic phase is washed with water, 5% aqueous sodium bicarbonate and water up to neutrality. After drying on Na₂SO₄, evaporation of the solvent, and purification of the residue by flash chromatography on silica gel, 2.4 g of the amide of (R) 2-[4-(1-oxo-2-isoindolinyl)phenyl]-3-oxo-valeric acid is obtained.

- 20 $[\alpha]_D = -46^\circ$ (c=1; CH₃OH); ¹H-NMR (DMSO-d₆); δ 7.70-7.55 (m, 3H); 7.45-7.30 (m, 3H); 7.15 (d, 2H, J=8Hz); 5.55 (bs, 2H, CONH₂); 4.67 (s, 2H); 3.75 (m, 1H); 3.52 (s, 2H); 25 1.60 (d, 3H, J=8Hz).

Example 15

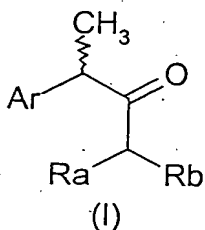
(R) 2-(4-(1-oxo-2-isoindolinyl)phenyl)-3-oxo-valeronitrile.

- Following the procedure of Example 14, and substituting the monoamide of malonic acid with equimolecular quantities of cyanacetic acid, (R) 2-(4-(1-oxo-2-isoindolinyl)phenyl)-3-oxo-valeronitrile is obtained.

30 $[\alpha]_D = -21^\circ$ (c=1; CH₃OH); ¹H-NMR (DMSO-d₆); δ 7.71-7.50 (m, 3H); 7.45-7.30 (m, 3H); 7.18 (d, 2H, J=8Hz); 4.65 (s, 2H); 3.72 (m, 1H); 3.63 (s, 2H); 1.55 (d, 3H, J=8Hz).

CLAIMS

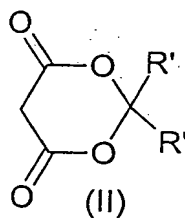
1. (R,S) -1-Arylethylketone compounds of formula I and their single (R) and (S) enantiomers:



wherein:

Ar is an aryl group;

Ra and Rb are independently chosen in the group of hydrogen, linear or branched C₁-C₆ alkyl, phenyl, α -or β -naphthyl, 2, 3, 4-pyridyl, C₁-C₄-alkylphenyl, C₁-C₄-alkyl(α -or β -naphthyl), C₁-C₄-alkyl(2, 3, 4-pyridyl), cyano (-CN), carboxamide, carboxyl or carboxyesters of formula CO₂R" wherein R" is the residue of a linear or branched C₁-C₆ aliphatic alcohol, a phosphonate PO(OR")₂ wherein R" is as defined above, a group of formula di-X-(CH₂)_n-Z, wherein X is a CO, SO, SO₂ group; Z is H, *tert*-butyl, isopropyl, CO₂R", CN, phenyl, α -or β -naphthyl, 2, 3, 4-pyridyl, C₃-C₆ cycloalkyl, NH-BOC, NH₂; n is zero or an integer from 1 to 3; or Ra and Rb, with the carbon atom to which they are bound, form a cyclic residue 4, 6-dioxo-1, 3-dioxanyl-2, 2-disubstituted of formula II:



wherein R' is methyl or ethyl, or the two groups R' form a cyclohexane or cyclopentane ring with the exclusion of:

- (R, S) -(+)-2-butanone, 3-[4-(2-methylpropyl)phenyl];
 (R, S) -(+)-2-butanone, 3-(3-phenoxyphenyl);

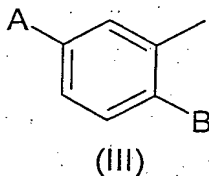
(*R, S*) (+)-2-butanone, 3-(3-benzoylphenyl);

ethyl (*R, S*) (+)-4-(3-benzoyl-phenyl)-3-oxo-pentanoate;

(*R, S*)(+)-1,3-dioxan-4, 6-dione-5-[2-(3-benzoylphenyl)-1-oxopropyl]-2,2-dimethyl.

2. Compounds according to Claim 1, wherein Ar represents phenyl, optionally substituted by one to three substituents, which are the same or different from one another, selected from:

halogens, C₁-C₄-alkyl, C₁-C₄-alkoxy, hydroxy, C₁-C₄-acyloxy, phenoxy, cyano, nitro, amino, C₁-C₄-acylamino, halogen-C₁-C₃-alkyl, halogen C₁-C₃-alkoxy, benzoyl, or a residue 4-isobutyl-phenyl, 3-benzoylphenyl, 5-benzoyl-2-acetoxy-phenyl, 3-phenoxy-phenyl, 5-benzoyl-2-thiophenyl, 4-thienoyl-phenyl, 1-oxo-2-isoindolinyl-phenyl, 3-chloro-4-(2,5-dihydro-1H-pyrrol-1-yl)phenyl, 6-methoxy-β-naphthyl, 1-hydroxy-phenyl-1-methyl, or a residue of formula III:

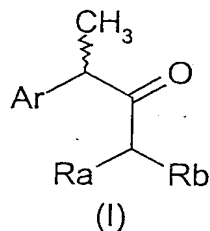


wherein A is benzyl, phenoxy, benzoyl, benzoyloxime, 1-hydroxy-phenyl-1-methyl, B is hydroxy, C₁-C₄-acyloxy or a group of formula -O-C(=S)-N(CH₃)₂, or -S-C(=O)-N(CH₃)₂.

3. Compounds according to Claim 2 wherein Ar is the residue 4-(2-methyl-propyl)-phenyl, 3-phenoxy-phenyl, 3-benzoylphenyl, -2-[4-(1-oxo-2-isoindolinyl)phenyl], 5-benzoyl-thien-2-yl or 4-thienoyl-phenyl.

4. Compounds according to any one of Claims 1 to 3, wherein the steric configuration of the carbon atom to which the residue Ar is bound corresponds to the enantiomer (*R*).

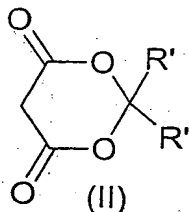
5. (*R, S*)-1-Arylethylketone compounds of formula I and their single (*R*) and (*S*) enantiomers:



wherein:

Ar is an aryl group;

Ra and Rb are independently chosen in the group of hydrogen, linear or branched C₁-C₆ alkyl, phenyl, α-or β-naphthyl, 2, 3, 4-pyridyl, C₁-C₄-alkylphenyl, C₁-C₄-alkyl(α-or β-naphthyl), C₁-C₄-alkyl(2, 3, 4-pyridyl), cyano (-CN), carboxyamide, carboxyl or carboxyesters of formula CO₂R'' wherein R'' is the residue of a linear or branched C₁-C₆ aliphatic alcohol, a phosphonate PO(OR'')₂ wherein R'' is as defined above, a group of formula di-X-(CH₂)_n-Z, wherein X is a CO, SO, SO₂ group; Z is H, *tert*-butyl, isopropyl, CO₂R'', CN, phenyl, α-or β-naphthyl, 2, 3, 4-pyridyl, C₃-C₆ cycloalkyl, NH-BOC, NH₂; n is zero or an integer from 1 to 3; or Ra and Rb, with the carbon atom to which they are bound, form a cyclic residue 4, 6-dioxo-1, 3-dioxanyl-2, 2-disubstituted of formula II:

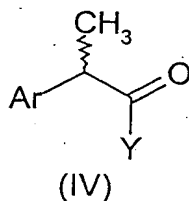


wherein R' is methyl or ethyl, or the two groups R' form a cyclohexane or cyclopentane ring;
for use as medicaments.

6. Compounds according to Claim 5 for use as inhibitors of IL-8 induced chemotaxis of human PMNs.

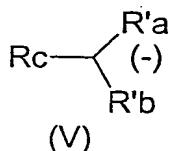
7. Pharmaceutical compositions containing a compound according to any one of Claims 1 to 6 in admixture with a suitable carrier thereof.

8. Use of the compounds according to any one of Claims 1 to 6 in the preparation of medicaments for the treatment psoriasis, rheumatoid arthritis, ulcerative colitis, acute respiratory distress syndrome (ARDS), idiopathic fibrosis, glomerulonephritis, bullous pemphigo and for the prevention and the treatment of damages caused by ischemia and reperfusion.
9. Process for the preparation of compounds according to any one of claims 1 to 6 comprising the reaction of an activated 2-arylpropionic acid of formula (IV)



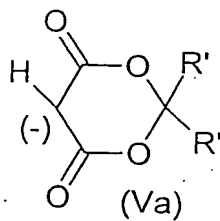
wherein

10. Ar is an aryl group and Y is a residue activating the carbonyl, such as halogen, 1-imidazolyl, pivaloyl, C₁-C₃-alkoxycarbonyl, succinyloxy, benzo-triazol-1-yloxy with a carbanion of formula V:



wherein:

15. - when R'a is the residue of a complex between a carboxyl and magnesium ethoxide, R'b is CO₂R'', CONH₂, CN, PO(OR'')₂ or -X-(CH₂)_n-Z', where X is as defined previously; R'c is H or -(CH₂)_n-Z', where Z' is H, *tert*-butyl, isopropyl, CO₂R'', CN, phenyl, α- or β-naphthyl, 2, 3, 4-pyridyl, C₃-C₆ cycloalkyl, NH-BOC;
20. - when R'a is hydrogen and R'c is hydrogen or a -(CH₂)_n-Z'-radical, as defined above, R'b is phosphonate PO(OR'')₂, CO₂R'', or R'a and R'b with the carbon atom to which they are bound, form the carbanion of 2, 4-dioxo-1, 3-dioxanyl of formula Va:



wherein R' is methyl or ethyl, or the two groups R' form a cyclohexane or cyclopentane ring.

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 03/13946

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C07C69/612 C07C69/78 C07C49/213 C07C49/784 C07C271/18
 C07C309/65 C07C317/06 C07C311/21 C07D213/50 C07D209/46
 C07D319/06 C07F9/40 A61K31/222 A61P29/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C07C C07D C07F A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, BEILSTEIN Data, WPI Data, PAJ, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275017 Database Accession Nos. 1942753, 1943166, 1943612, 1943613, 1945434, 1945435, 1945436, 1945437, 1948204, 1950022, 1968443, 2362885, 2447357, 2451750 (BRN's). & CHIM. THER., vol. 3, 1968, pages 313-320,	1,2
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275018 Database Accession Nos. 1955069, 1958359 (BRN's). -/-	1



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

Date of the actual completion of the international search

31 March 2004

Date of mailing of the international search report

16/04/2004

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Weisbrod, T

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	& BULL. SOC. CHIM. FR., 1974, pages 1415-1420, -----	
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275019 Database Accession Nos. 2104506, 2451415 (BRN's). & J. AM. CHEM. SOC., vol. 103, no. 11, 1981, pages 3088-3093, -----	1,2,4
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275020 Database Accession No. 3242777 (BRN). & J. AM. CHEM. SOC., vol. 81, 1959, pages 5193-5197, -----	1,2
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275021 Database Accession No. 2842765 (BRN). abstract & ACTA CHEM. SCAND., vol. 20, 1966, pages 2467-2479, -----	1,2
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275022 Database Accession Nos. 3033411, 3651979, 3651980 (BRN's). & J. MED. CHEM., vol. 33, no. 6, 1990, pages 1741-1748, -----	1,2,4
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275023 Database Accession No. 4661814 (BRN). & BULL. CHEM. SOC. JPN., vol. 64, no. 11, 1991, pages 3473-3475, -----	1,2,4
X	DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275024 Database Accession No. 5013506 (BRN). & TETRAHEDRON LETT., vol. 27, no. 35, 1986, pages 4175-4176, -----	1-3
	----- -/--	

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275025 Database Accession Nos. 5379213, 5379214 (BRN's). & J. AM. CHEM. SOC., vol. 105, no. 5, 1983, pages 1309-1316,</p>	1,2,4
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275026 Database Accession No. 6863126 (BRN). & J. ORG. CHEM., vol. 50, no. 9, 1985, pages 1504-1509,</p>	1,2
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275027 Database Accession No. 6978265 (BRN). & FARMACO ED. SCI., vol. 40, no. 12, 1985, pages 942-955,</p>	1,2
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275028 Database Accession No. 7020327 (BRN). & TETRAHEDRON ASYMMETRY, vol. 5, no. 9, 1994, pages 1763-1780,</p>	1,2,4
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275029 Database Accession No. 4981202 (BRN). & SYNTH. COMMUN., vol. 24, no. 2, 1994, pages 145-152,</p>	1,2
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275030 Database Accession Nos. 3292936, 8911430, 8911858, 8912139, 8912482 (BRN's). & J. MED. CHEM., vol. 44, no. 16, 2001, pages 2544-2554,</p>	1,2,9
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275031 Database Accession No. 5535609 (BRN). -/--</p>	1-3

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/13946

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>& . CHEM. LETT., 1982, pages 597-600, -----</p> <p>JP 05 286902 A (SUMITOMO PHARMACEUT CO. LTD) 2 November 1993 (1993-11-02) Page 5: present compound (I) wherein Ar = 3-benzoylphenyl, Ra = H, Rb = COO-t-Bu. -----</p>	1-3,9
X	<p>DATABASE BEILSTEIN BEILSTEIN INSTITUTE FOR ORGANIC CHEMISTRY, FRANKFURT-MAIN, DE; XP002275032</p>	1,5,7,8
Y	<p>Database Accession No. 6727608 (BRN). & FARMACO, ED. SCI., vol. 36, no. 12, 1981, pages 1037-1056, XP0009028407 Page 1046 and page 1049 (table III), compound (XXV). -----</p>	2-4,6
Y	<p>WO 01/58852 A (ALLEGRETTI MARCELLO ; CESTA MARIA CANDIDA (IT); COLOTTA FRANCESCO (IT)) 16 August 2001 (2001-08-16) Abstract; claims; pages 1-5. -----</p>	1-8 wo/155
Y	<p>WO 00/24710 A (ALLEGRETTI MARCELLO ; CESTA MARIA CANDIDA (IT); COLOTTA FRANCESCO (IT)) 4 May 2000 (2000-05-04) Abstract; claims; pages 2-3. -----</p>	1-8 wo/148

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 1-4 (all part)

The initial phase of the search revealed a very large number of documents relevant to the issue of novelty of the present claims 1-4. Alone the search in the Beilstein Crossfire database resulted already in more than 200 novelty interfering hits. A random selection is represented by the first 15 documents cited in the search report. So many documents were retrieved that it is impossible to determine which parts of these claims may be said to define subject-matter for which protection might legitimately be sought (Article 6 PCT). For this reason, a meaningful search over the whole breadth of the claims 1-4 is impossible. Consequently, the search has been restricted to the medical use of compounds (I) as defined in claim 5, and to compounds (I) per se (i.e. claims 1-4 partially) wherein Ar is phenyl substituted by one to three substituents selected from isobutyl, benzoyl, benzoyloxy, phenoxy, 1-oxo-isoindolin-2-yl, sulfonyloxy, and sulfonamido. This covers the examples listed on pages 6 and 7 of the description.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 1-4 (all part)
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest :

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 03/13946

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 5286902	A	02-11-1993	NONE	
WO 0158852	A	16-08-2001	IT MI20000227 A1	13-08-2001
			AU 4412501 A	20-08-2001
			BR 0108152 A	25-03-2003
			CA 2396937 A1	16-08-2001
			CZ 20022728 A3	15-01-2003
			EE 200200441 A	15-12-2003
			WO 0158852 A2	16-08-2001
			EP 1255726 A2	13-11-2002
			HU 0301576 A2	28-11-2003
			JP 2003522750 T	29-07-2003
			NO 20023817 A	12-08-2002
			SK 11412002 A3	09-01-2003
WO 0024710	A	04-05-2000	IT 1303249 B1	06-11-2000
			AT 230723 T	15-01-2003
			AU 769850 B2	05-02-2004
			AU 1037500 A	15-05-2000
			BR 9914741 A	03-07-2001
			CA 2347752 A1	04-05-2000
			CN 1324344 T	28-11-2001
			CZ 20011441 A3	17-10-2001
			DE 69904852 D1	13-02-2003
			DE 69904852 T2	13-11-2003
			DK 1123276 T3	28-04-2003
			EE 200100233 A	15-08-2002
			WO 0024710 A1	04-05-2000
			EP 1123276 A1	16-08-2001
			ES 2190264 T3	16-07-2003
			HU 0103793 A2	28-03-2002
			JP 2002528434 T	03-09-2002
			NO 20012000 A	20-06-2001
			NZ 511077 A	29-08-2003
			PL 347947 A1	22-04-2002
			PT 1123276 T	30-04-2003
			SK 5382001 A3	03-12-2001
			TR 200101124 T2	22-10-2001
			US 2003216392 A1	20-11-2003

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